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<b>(21) International Application Number:</b> PCT/GB90/00398 <b>(22) International Filing Date:</b> 16 March 1990 (16.03.90)  <b>(30) Priority data:</b> 8906100.6                      16 March 1989 (16.03.89)                      GB  <b>(71) Applicant (for all designated States except US):</b> SMITH & NEPHEW PLC [GB/GB]; 2 Temple Place, Victoria Embankment, London WC2R 3BP (GB).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only) :</b> SMITH, Mark, Frederick [GB/GB]; 4 Red Cottages, The Street, Sheering, Bishops Stortford, Hertfordshire CM22 7LT (GB). BLOTT, Patrick, Lewis [GB/GB]; 55 Godwin Style, Bishops Stortford, Hertfordshire CM23 4ER (GB).		<b>(74) Agent:</b> HOBBS, J., D.; Smith & Nephew plc, Corporate Patents & Trade Mark Department, Gilston Park, Harlow, Essex CM20 2RQ (GB).  <b>(81) Designated States:</b> AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB, GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent), US.  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
<b>(54) Title:</b> ABSORBENT DEVICES AND PRECURSORS THEREFOR  <b>(57) Abstract</b>  <p>An absorbent device comprises an absorbent layer having an apertured contoured polymer film attached to one surface which surface is provided with a plurality of depressions which communicate directly with the apertures in the film. The device may be produced by separating the polymer film and a carrier material which have been formed into a laminate having impressed therein raised areas defining for example the strands of a net and depressed areas such that upon separation the depressed areas of the film remain attached together with associated portions of the attached absorbent, to the carrier, leaving the raised areas attached to the remainder of the absorbent.</p>		

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ABSORBENT DEVICES & PRECURSORS THEREFOR

The present invention relates to absorbent devices, to a laminate which is a precursor for an apertured and contoured film or net and to the film or net itself. The present invention also relates to processes for preparing absorbent devices the laminate and apertured film or net formed therefrom and to the use of the film or net as a body contacting layer in absorbent products such as dressings and hygienic devices.

Absorbent devices such as dressings and hygienic devices conventionally employ a water permeable film for their body contacting surface to act as a barrier between the body surface and the absorbent. A wound contacting layer, for example, for use in a dressing should also be conformable, non-adherent to the wound and to act as a means of preventing the healing wound incorporating the absorbent material into regenerating surface. One successful non-adherent absorbent wound dressing comprises a hydrophilic polyurethane foam bonded to a wound contacting layer comprising an elastomeric separator layer which is the polymer net.

Those dressing may be made by casting the net in a mould and then casting the foam on top of the net. This process involves many steps, expensive raw materials and imperfections in the mould may cause uneven net strand thickness and prevent clean release of the net from the mould. A further disadvantage is that the surface of the absorbent between the strands may be very close to the surface of the dressing hence presenting an opportunity for the absorbent to become incorporated in the healing wound or for the dressing to be more adherent than desirable under some circumstances.

The present invention accordingly provides an absorbent device comprising an absorbent layer and an apertured contoured polymer film attached to one surface which surface is provided with a plurality of depressions which communicate directly with the apertures in the film.

The absorbent device is preferably a wound dressing. It has been found that such dressings allow for excellent healing of the wound, do not adhere significantly and easier to manufacture than prior art dressings.

The apertured contoured polymer film is a three-dimensional structure whose major surfaces are in spaced apart planes. The major surfaces of this structure are defined respectively by one surface of the raised portions of the contoured film and by the opposed surface of depressed portions of the film. The apertures in the film preferably all lie in the plane defining one of the major surfaces of the film and it is to this surface that the second layer is attached to the first layer. The apertures in the second layer register with voids formed by the depressions in the surface of the absorbent layer but the film material does not normally extend significantly into the voids.

The apertures in the film may be of a size and shape to give the apertured film the appearance of a net. For example, if the apertures are quadrilaterals, the non-apertured part of the film will resemble the strands and junctures of a net. Circular or other non-rectilinear apertures may give the apertured film a different appearance. The apertured contoured film is preferably a net having strands and junctures formed from the polymer material.

A process has also now been found which makes the task of preparing a net or apertured contoured film suitable for use, for example as a wound contacting layer cheaper and simpler. The separator layers when used in dressings have been found to possess advantages over the separator layers previously used. These advantages occur as a result of the process used for their manufacture. The second or separator layer employed in the absorbent devices of the invention may be formed by laminating together a carrier material and a film which is to form the apertured or contoured film under conditions such that the laminate possesses an impressed pattern of raised areas, eg. defining the strands of a net. Between these areas or strands are defined membrane areas which are depressed areas in the film. Separation of the film from its carrier again by peeling them apart results in the membrane areas of the

film remaining adhered to the carrier material and the intersecting strands remaining, form the net. The laminate possessing these properties is novel. The production of the net via the laminate is simple, quick and not wasteful of raw materials.

The present invention also provides a laminate having impressed therein a pattern of raised areas with depressed areas therebetween said laminate comprising a carrier material and a film, wherein said film and material are attached to each other such as to permit, upon separation, the membrane areas of the film to remain attached to the carrier material.

In another aspect, the present invention provides a contoured apertured film which has been produced by the separation of a contoured polymer film and a carrier material which have been formed into a laminate having impressed therein a pattern of raised areas of the net and depressed areas said film and carrier material being attached to each other such that upon separation thereof the depressed areas of the contoured film.

In a preferred embodiment of the invention the laminate is impressed with a pattern of raised areas which will define the intersecting strands of a net.

The depressed areas define a membrane between the strands and upon separation of the carrier from the contoured film the membrane areas rupture to form the apertures of the net and the remaining, raised areas define the intersecting strands of the net.

A major advantage has been recognised in the preparation of dressings in which the net is adhered to an absorbent material. The absorbent material such as a foam may be cast onto the contoured film of the laminate before separation of the film and its carrier. In this method there is no risk of the foam exuding through the openings in the film since the film is not yet apertured. Separation of the carrier material from the foam coated film now not only removes the membrane areas but will also remove a little of the foam from between the strands which has adhered to the membrane areas. This results in deeper depressions in the foam surface between the strands so reducing the risk of the foam surface ever contacting the healing wound and also makes more surface of the foam available from absorbing body fluids.

The carrier material can be any deformable material. Aptly it can be a plastics film and preferably can be a thermoplastic film in which the polymer which forms the film can have a melting point



above that of the polymer forming the contoured film. Suitable films include polyolefin and polyester films, for example low density polyethylene or a polyester film, available as Melinex (Trade mark) and polyamide materials such as Nylon films. Other deformable materials which are suitable include cellulosic products such as PVdC laquered cellulose and nitocellulose coated cellulose and uncoated products such as those sold under the trade name Cellophane and paper. The carrier material may be of any desirable thickness provided that, when laminated to the net-forming film, it is capable of being embossed and retaining the debossant. Aptly the carrier material will be at least  $30\mu\text{m}$  thick. The thickness of the carrier material can be from 50 to  $250\mu\text{m}$ , more suitably can be 100 to  $175\mu\text{m}$  and is preferably 125 to  $150\mu\text{m}$ .

The material for forming the apertured contoured film can be a polymer which flows under the influence of pressure and/or heat.

Aptly the film comprises an elastomer and preferably a thermoplastic elastomer.

Apt materials for use in forming the apertured contoured film include di- and tri-block copolymers such as those of hard block materials such as styrene

with softer block elastomeric materials such as isoprene or butadiene. Suitable materials in this group include block copolymer sold under the trade names KRATON and CARIFLEX.

Other apt elastomers for use in forming the apertured contoured film include hydrocarbons such as polyethylene or polyisobutadiene, polyester ether, polyester amides, polyurethanes and other copolymers such as ethylene-vinyl acetate copolymers or mixtures of such elastomers.

Suitable polyether-amide elastomers are disclosed in British Patent 1473972, French Patent Nos. 1444437 and 2178205 and United States Patent No. 3839245. An apt polyether-amide is known as Pebax 2533 SN00 available from ATO Chemical Products (UK) Limited. This polymer has a water content of approximately 55% when hydrated.

Suitable polyether-ester elastomers for use in the invention are known as Hytrel available from Du Pont (UK) Limited. An apt grade is known as Hytrel 4036.

Suitable polyurethane elastomers for use in the films used in the invention include relatively

non-hydrophilic linear polyester polyurethanes and linear polyether polyurethane elastomers for example those known as Estanes available from BF Goodrich (UK) Limited. Apt grades are Estanes 5701, 5702, 5714 and 58201.

Hydrophilic polyurethane elastomers, for use in the invention, can aptly have a water content when hydrated of at least 5% by weight. Suitably such elastomer may absorb upto 70% by weight, desirably from 10% to 40% by weight and preferably from 20% to 30% by weight, for example 25% by weight, water when hydrated. Suitable hydrophilic linear polyurethane elastomers for use in the invention are described in United Kingdom Patent No. 2093190.

Other suitable elastomeric acrylic polymers such as a copolymer of alkoxy alkyl acrylate or methacrylates, as for example those described in United Kingdom Patent Specification No. 1280631 and ethylene-acrylic acid or acrylic ester polymers such as those sold under the trade name PRIMACOR and LOTADUR.

Preferably the material for forming the apertured contoured film is a blend, suitably a blend of an elastomeric material with an incompatible more rigid polymeric material. Such blends may comprise the above

described elastomeric materials with a polyolefin such as polyethylene, polystyrene polycyclooctene or polypropylene.

Suitable blends include those of ethylene-vinyl acetate copolymers, polyurethane or polybutadiene with an incompatible polymers such as a polyolefin, for example polystyrene. Such blends are described for example in European Patent Specification Nos. 0141542 and 0046071 and in United Kingdom Patent Specification No. 2103537. Other preferred blends include those polyether-amides with high impact polystyrene, non-hydrophilic polyurethanes with hydrophilic polyurethanes, and polyurethane with linear low density polyethylene.

The ratio of elastomeric material to the other blend components is desirably chosen so that the elastomeric materials form the continuous phase of the blend and the other materials are in the discrete or discontinuous phase. Generally the elastomeric components will form at least 50% by weight of the blend. Aptly the blend will contain upto 90% by weight of the elastomeric components. Suitably the blend will contain between 55 and 85% of the elastomeric components. Certain ethylene polymers such as low density polyethylene and linear low density

polyethylene exhibit some elastic properties therefore may be considered to be part of the elastomeric components of blends containing such materials.

Preferred blends of an ethylene-vinyl acetate copolymer comprise from 10% to 90% by weight of ethylene-vinyl acetate copolymer more preferably 20 to 80% by weight of ethylene-vinyl acetate copolymer. Typical examples of such a blend comprises a blend of 40 parts ethylene-vinyl acetate copolymer and 60 parts high impact polystyrene, or a blend of about 25 parts ethylene-vinyl acetate copolymer, about 13 parts high impact polystyrene and about 60 parts linear low density polyethylene or a blend of from 40 to 90 parts by weight of ethylene-vinyl acetate copolymer and 60 to 10 parts by weight of high impact polystyrene.

The thickness of the film can be upto  $250\mu\text{m}$ , suitably from 25 to  $200\mu\text{m}$ , more suitably can be upto 150 to  $175\mu\text{m}$  and is preferably from 30, more preferably from 60 to  $150\mu\text{m}$ .

The films for forming the second layer may include filler materials or whitening agents such as calcium carbonate, titanium dioxide and the like. A suitable filled film is a polyethylene containing calcium carbonate.

The laminate can have membrane areas of any shape that can be produced by embossing. Such areas may be circular, elipsoidal, polygonal such as hexagonal or of more complex shape such as lobate, eg. trifoliate shape. Preferably the membrane areas are, quadralateral eg. diamond shaped or rectangular, for example they may be square. The membrane areas can have dimensions of from 0.02 to 4mm, more suitably can be from 0.05 to 2.5mm and preferably from 0.1 to 2mm. These dimensions are based on the side of a rectangle, other shaped areas will have areas and dimensions corresponding to major axes of the shape.

The depressed or membrane area can form at least 15% of the surface area of the laminate. Suitably the membrane area will form upto 80%, more suitably from 25 to 75% and preferably from 25 to 65% of the surface area of the laminate.

The laminate can have depressed areas corresponding to from 2 to 40 strands per cm of film surface, more suitably can have 3 to 40 strands per cm and preferably can have 4 to 24 strands per cm in both longitudinal and transverse directions.

The thickness of the embossed film ie. distance

between the planes of the major surfaces of the second layer can be from 0.1mm to 0.5mm and is preferably 0.15 to 0.4mm.

When the film is removed from the carrier material the film fractures around the perimeter of the membrane area to form apertures. The apertures in the film are equivalent area to the membrane areas described above. The strands or depressed areas in the apertured film retain their three dimensional character that is retain an arch shaped profile.

The laminate can be prepared by leading the carrier material and the polymer film together through the nip of two rollers. The first roller is a hard steel roller coated with a smooth rubber such as Hypolon (Trade mark). Generally, this roller is not heated. the roller contacts the film. The second roller is a steel roller which has an embossed pattern in its surface. A preferred embossed pattern can be of individual truncated square pyramids with troughs between the base edges of the pyramids. This roller can be heated. The film and carrier are laminated as they pass between the plain roller. The film and carrier passing between the plain roller and raised areas of the embossed roller form the membrane areas. The film and carrier deform into troughs between the

depressed areas to form the raised areas or strands. The film and carrier leave the nip as a laminate with an impressed pattern of strands with the membrane areas in between. The net or apertured film is formed by peeling apart the film and carrier. The film fractures around the laminated membranes so that the membrane areas of the net-forming film remain adhered to the carrier material and the intersecting strands form the net.

Thus, the adhesive strength between the carrier and the film in the membrane region has to be greater than that in the region of the strands or raised areas and the adhesive strength in the absorbent should be less than the adhesive strength between the carrier and the film in the membrane region.

The pattern of the impressed raised areas or strands and depressed areas or membranes can depend upon the pattern engraved on the surface of the roller. Unequal density of strands in either longitudinal or transverse directions may lead to rectangular holes in the net; likewise continuous parallel strands in one direction with staggered arrangement of strands in the other direction can lead to brickwork pattern; strands arranged at angles to each other can give a diamond pattern and different shaped



embossments, for example circular or hexagonal can lead circular or hexagonal apertures respectively. The engraved surface can contain mixed patterns or may contain plain areas where no pattern is impressed or laminate is formed.

In another aspect therefore, the present invention provides a process for the preparation of a laminate having a pattern of raised areas defining strands with depressed areas therebetween defining membrane areas and comprising a carrier material and a polymer film which can be separated after lamination such that the membrane area of the film remains attached to the carrier material and the strands form a contoured apertured film net which process comprises laminating the films together between a plain and embossed surface under the influence of heat and/or pressure.

In another aspect, the present invention provides a process for the preparation of a contoured apertured film or net which comprises separating the film and its carrier forming the laminate described hereinbefore.

If the apertured contoured film or net is to form the wound contacting layer of an absorbent dressing in which an absorbent material is attached to the net,

then it is advantageous to attach the absorbent to the film before this film is removed from the carrier material to form the apertured contoured film net. Removal of the carrier material provides an absorbent material having one surface attached to a net.

Accordingly in another aspect the present invention comprises a laminate as hereinbefore described which has additionally an absorbent material attached to the surface of the polymer film remote from the carrier material.

Suitably the surface of the polymer film to which the absorbent is to be attached may be treated to enhance bonding. Such treatments can include a corone-discharge treatment of the film or the application of a suitable adhesive thereto.

The absorbent material employed in the absorbent layer can be any one of those conventionally used in absorbent dressings including gauze, wood pulp, cotton webs, rayon fibres and foams especially hydrophilic foams. Preferably the absorbent material is a foam. More preferably the absorbent layer comprises a conformable, hydrophilic foam. Apt foams may be made from polyurethane, carboxylated butadiene-styrene rubber, polyacrylate, polyester foams, hydrophilic

epoxy foams and hydrophilic polyurethane foams described in European Patent Application No. 299122 which are incorporated herein by cross-reference.

Favoured hydrophilic polymer foams are formed from hydrophilic polyurethane especially cross-linked hydrophilic polyurethane. Such hydrophilic polyurethanes will generally absorb at least 5% by weight of water when hydrated and aptly will absorb upto 300 or 400% of their weight of water when fully hydrated. Preferred foams include those described in European Patent Specification No. 299122 and known as Hypol foams made from Hypol hydrophilic isocyanate terminated prepolymers (Hypol is a trade mark and is available from W.R. Grace and Co). The prepolymers are mixed with water and coated onto the net-forming film of the laminate where foaming occurs. The foam is then cured. The carrier material may then be removed. Removal of the carrier material results in not only removal of the membrane areas of the film but also a small amount of foam attached to them. The recesses between the strands are noticeably deeper than observed previously which means that the absorbent surface is at greater distance from the wound surface and hence is less likely to become integrated with the healing wound.

Aptly the absorbent material can have a thickness of at least 0.5mm and suitably will have a thickness upto to 20mm. More suitably the absorbent will be 1 to 15mm preferably 2 to 10mm, for example 4mm, 6mm, or 8mm, thick.

If the absorbent material is other than a foam an adhesive may be used to adhere the absorbent to the film or laminate. Removal of the carrier film removes the membrane areas and cause cohesive failure in the absorbent material so a little absorbent is removed from the area between the strands as before.

In yet another aspect, the present invention provides a process for the preparation of a foam-coated laminate, said laminate having impressed therein a pattern of raised areas defining intersecting strands having membrane areas defined therebetween and comprising a carrier material and a contoured polymer film which can be separated after lamination such that the membrane areas of the film remain attached to the carrier material and form apertures in the film which process comprises laminating a polymeric film and carrier therefore together between a plain and embossed surface under the influence of heat and/or pressure forming a foam on the surface of the laminate and curing the foam.

In another aspect, the present invention comprises a process for preparing a wound dressing which comprises separating the carrier material from the foam-coated laminate described hereinbefore.

The absorbent material can contain topically effective medicament. Most suitably the medicament is an antibacterial agent. Preferably the antibacterial agent is a broad spectrum antibacterial agent such as silver salt such as silver suphadiazine, an acceptable iodine source such as polyvinyl pyrrolidone-iodine, chlorhexidine salts such as digluconate, diacetate, dihydrochloride or the like or quaternary antibacterial agents such as benzalkonium chloride.

The medicament can be present in amounts of at least 0.2% by weight of the dressing, and aptly upto 20% by weight of the dressing. More suitably from 0.3 to 10% by weight and preferably 0.5 to 5% by weight of the dressing of medicament may be incorporated.

In another type of dressing, the surface of the foam may have continuous moisture vapour transmitting conformable film over the surface opposed to the attached to the contoured apertured film or net. This further film may be used to regulate the moisture loss

from the wound area under the dressing and also to act as a bacterial barrier to prevent bacteria penetrating to the wound area.

The moisture vapour permeability of a film is expressed by its moisture transmission rate and can be determined as follows.

Discs of the material under test were clamped over Payne Permeability Cups (flanged metal cups) using sealing rings and screw clamps. The exposed surface area of the test sample is  $10\text{cm}^2$ . Each cup contains approximately 10ml of distilled water.

After weighing the cups are placed in a fan assisted electric oven which is maintained at  $37\pm 1^\circ\text{C}$ . The relative humidity within the oven is maintained at 10% by placing 1Kg of anhydrous 3-8 mesh calcium chloride on the floor of the oven.

The cups are removed after 24 hours, allowed to cool for 20 minutes and re-weighed. The moisture vapour transmission rate of the test material is calculated from the weight loss and expressed in units of grams of weight per square metre per 24 hours. The units for moisture vapour transmission rate will hereinafter be expressed as gsm.

Apt continuous films can have a moisture vapour transmission rate of greater than  $300^{-2} \text{ 24h}^{-1}$  at  $37^{\circ}\text{C}$  and 100% to 10% relative humidity difference. Suitably the moisture vapour transmission rate not normally be greater than  $5000\text{gm}^{-2} \text{ 24h}^{-1}$  at  $37^{\circ}\text{C}$  and 100% to 10% relative humidity difference. Preferably, the moisture vapour transmission rate will be greater than 500, more preferably at least 700 and most preferably at least  $2000 \text{ gm}^{-2} \text{ 24h}^{-1}$  at  $37^{\circ}\text{C}$  and 100% to 10% relative humidity difference.

Suitable polymers for use as a continuous film include polyether or polyester polyurethane or blends of polyurethanes with incompatible polymers such as polyolefins, for example polystyrene and may include those materials described above for producing the contoured apertured film. Aptly the films will be at least 12.5 thick. Suitable films will be upto  $50\mu\text{m}$  thick, favourably between 25 and  $40\mu\text{m}$  thick.

Preferred polyurethane films are made from linear polyurethanes as hereinbefore described with respect to the wound facing layer. Favoured continuous films will be 12.5 micron to 37.5 micron thick. A preferred polyurethane for use in such thickness is Estane 5714F. A 25 micron thick film of Estane 5714F has a moisture

vapour transmission rate of approximately 1800gsm so that it may be employed to produce a moisture vapour transmission within the preferred range.

The outer layer can be a conformable polyurethane incompatible polymer blend film containing voids.

Suitable conformable polyurethane blend films are disclosed in United Kingdom Patent Application No. 8214250, now published as Application No. 2081721.

Apt conformable polyurethane blend film outer layers have a thickness 0.0125mm to 0.125mm. Such films can have a moisture vapour transmission rate of at least 500gsm and preferably at least 1000gsm.

A preferred polyurethane blend film comprises a blend of a linear polyurethane (60 parts by weight of Estane 580201 available from B.F. Goodrich) and a high impact polystyrene (40 part by weight of compound ref. 6MW available from R.H. Cole Limited). A favoured film of this composition has a thickness of 0.084mm and a moisture vapour transmission rate of 1660g/m<sup>2</sup>/24 hours at 37.5°C at 100% to 10% relative humidity difference.

The continuous film can be applied by spraying a solution of the polymer forming the film onto the foam



surface.

This in other aspects the present invention provides a foam-coated laminate as hereinbefore described in which the foam layer is attached to a continuous moisture vapour permeable film and a low wound adherency dressing form from this laminate.

The invention also provides a process for making this laminate and the dressing made by said process.

The laminate which includes the absorbent layer may be made available as a dressing precursor with the hospital personnel preparing the dressing in situ tearing off the carrier material.

The wound dressing aspect of this invention may be in any convenient form through a dressing of generally rectangular or circular shape may be preferred.

Suitable sizes for rectangular pads are from 5cm x 5cm to 30cm x 30cm. An alternative form is the form of an elongate strip which may be in the form of a roll.

Aptly absorbent devices of the invention,

including those having a continuous moisture vapour transmitting film over the absorbent layer will have a moisture vapour transmission rate of at least 300gsm, preferably at least 500gsm, more preferably more than 700gsm. The upper limit will be dictated by the moisture vapour transmission rate of the continuous film, if present. Absorptive devices, for example those suitable for use as wound dressings will have moisture vapour transmission rates of not more than 5000gsm more aptly not more than 3000gsm and preferably not more than 2000gsm.

It is desirable that the wound dressing aspects of this invention are sterile and are provided in bacteria impervious pouches. Such a packaged forms may be prepared under aseptic conditions from sterile components or may be sterilised after packing by a conventional procedure such as heat sterilisation or ethylene oxide or gamma irradiation.

The wound dressings of the present invention have improved adherency properties when compared with conventional foam-net dressings. We have observed that dressings in accordance with the invention may require only half the force required to remove a conventional foam-net dressing from equivalent wounds.

The absorbent devices of the invention may also be employed for use as first aid dressings. Additionally they may be employed as sanitary napkins and baby diapers.

#### Example 1

A polymer blend containing 90 parts by weight of ethylene-vinyl acetate copolymer (containing 28% vinyl acetate) and 10 parts by weight of high impact polystyrene and 4% by weight of the polymers of titanium dioxide was formed by mixing the polymers in a heated blade mixer, forming into a sheet and then granulating. The granules were formed into a film of thickness  $125\mu\text{m}$  by extrusion through the nip of a two roller casting unit. The film was taken upto a roll. This was the net-forming film.

The polymer blend film and carrier of low density polyethylene, of thickness  $150\mu\text{m}$ , were lead, in contact between the nip of two rollers. The first roller comprises a hard rubber coated roller devoid of pattern and at room temperature. This roller was in direct contact with the polymer blend film. The second roller comprised a heated steel roller engraved with a pattern of raised discrete truncated square pyramids. The

roller had a pattern of 4 x 4 raised areas per sq cm to truncated top of which had an area of 2 x 2mm. This roller contacted the polyethylene film. The influence of the heat and pressure produced a laminate of the two films which had impressed into it the pattern on the roller. The pattern comprised intersecting strands defining square membrane areas between them, neither film was apertured on leaving the nip between the rollers. The laminate may be stored on a roll.

#### Preparation of the Net

The net may be formed in the polymer blend film by separating it from the carrier. The membrane areas of the polymer blend film remain adhered to the polyethylene film. The net had approximately 16 apertures per sq cm each of which had an area of approximately 4 sq mm.

#### Example 2

A laminate formed by a similar method to that described in Example 1 was taken and onto the polymer blend surface was cast a hydrophilic polyurethane foam forming mixture. The mixture was formed by mixing Hypol FHP2002 and Brij 72 in the ratio 1:2.25 and coated via a fish tail die on to the laminate by means

of a knife over roller coating head set at a gap of 1mm. The cast foam was dried by passage through an air circulating oven at a temperature of 50°C for 5 minutes. The polyethylene film was peeled from the polymer blend film leaving the now apertured polymer blend film adhered to the foam. The material can be used as an absorbent wound dressing in which the apertured polymer blend film forms the contacting layer.

### Example 3

A polyethylene film-polymer blend film-foam laminate was prepared as described in Example 2. A solution containing 2% by weight of a polyurethane (Estane 5714F) in a mixture of tetrahydrofuran and acetone as solvent was hand sprayed on to the foam surface using an air spray unit and dried by passage through a air circulating oven heated to a temperature of 70°C.

The polyurethane coating was observed to be continuous and had a weight per unit area of 30 grams per square metre.

The polyethylene film was peeled from the polymer blend film to form the apertures. The film-foam-film

laminate could be cut into pieces suitable for use as a absorbent wound dressing and packaged in a bacteria proof pack and sterilised in a conventional manner, for example by gamma irradiation.

#### Example 4

A laminate was formed in a similar manner to that described in Example 1. The net-forming film of the laminate was coated with a foam formed in the following way, polyethylene glycol nonyl phenyl ether (Anterox CO-520, 1 mole) was mixed with an aliphatic isocyanate (Desmodur N 100, 3 moles) and dibutyl tin di laurate as catalyst in a wide necked jar at a temperature to maintain the components fluid. The reaction product was used to form a foam by mixing with 10% by weight of water. The foaming mixture while fluid was cast onto the net-forming film by the method described in Example 2. The preparation of the foam is described as Example 17 of European Patent Application No. 299122.

#### Example 5

A control wound dressing was manufactured according to the method described in European Patent Specification No. 059049 except that the polyurethane foam was that described in Example 17 of European

Patent Specification No. 299122.

The foam was cast onto an Estane net, which itself had been cast onto a polypropylene carrier. A 20 grams per square metre Estane film was then applied to the top surface of the foam and once the foam had cured the carrier was removed.

The thus formed dressing, after sterilisation was applied to a partial thickness wound and held in place by adhesive tape for four days.

A dressing as described in Example 4 was placed on a similar partial thickness wound and also held in place by adhesive tape for four days.

The dressing was removed by first removing the adhesive tapes whilst holding the dressing against the body. The dressings were then removed using a Nene tensile testing machine to measure the force required to break the bond between the dressing and the healing wound surface.

In both cases the dressings were removed cleanly leaving no residues on the healing wound surface. The force required to remove the Control dressing measured 97.68 on the testing machine whereas that required for removing the dressing of the invention was only 40.40.

CLAIMS

1. An absorbent device comprising an absorbent layer having an apertured contoured polymer film attached to one surface which surface is provided with a plurality of depressions which communicate directly with the apertures in the film.

2. An absorbent device comprising an absorbent layer and an apertured contoured polymer film attached thereto which apertured contoured polymer film has been produced by the separation of a contoured polymer film and a carrier material which have been formed into a laminate having impressed therein a pattern of raised areas and depressed areas therebetween, said film and carrier being attached to each other such that upon separation the depressed areas of the film remain adhered to the carrier thereby forming apertures in the contoured film.

3. A device as claimed in claim 1 or claim 2 wherein the contoured apertured film is a net.

4. A device as claimed in any one of the preceding claims wherein the polymer film comprises an elastomer.



5. A device claimed in claim 4 wherein the elastomer is a thermoplastic elastomer.
6. A device as claimed in any one of the preceding claims wherein the film polymer is a polymer blend.
7. A device as claimed in any one of the preceding claims wherein the polymer blend is a blend of an elastomer and a more rigid polymer.
8. A device as claimed in claim 6 or claim 7 wherein the elastomer comprises the continuous phase of the blend.
9. A device according to any one of claims 4 to 8 wherein the elastomer is an ethylene-vinyl acetate copolymer, a polyurethane or a polyether polyamide.
10. A device as claimed in any one of the preceding claims wherein the film polymer comprises a polyolefin.
11. A device as claimed in any one of the preceding claims comprising a further layer of a continuous moisture vapour permeable film attached to the surface of the absorbent layer opposed to that attached to the second layer.

12. A device as claimed in claim 10 wherein the further layer has a moisture vapour transmission rate of at least 300gsm.

13. A device as claimed in claim 11 or claim 12 wherein the further layer has a moisture vapour transmission rate of not more than 5000gsm.

14. A device as claimed in any one of claims 11 to 13 wherein the moisture vapour permeable film is made of an elastomeric material.

15. A device as claimed in claim 14 wherein the elastomeric material comprises a polyurethane, an ethylene-vinyl acetate copolymer or a polyether-polyester.

16. A device as claimed in any one of the previous claims wherein the absorbent material is a foam.

17. A device as claimed in claim 16 wherein the foam is a polyurethane foam.

18. A device as claimed in claim 17 wherein the polyurethane is a hydrophilic polyurethane.

19. A device as claimed in any one of the preceding claims having a moisture vapour transmission rate of at least 300gsm.

20. A device as claimed in any one of the preceding claims having a moisture vapour transmission rate of upto 2000gsm.

21. A device as claimed in any one of the preceding claims in the form of a wound dressing.

22. A device as claimed in any one of the preceding claims in the form of a sanitary towel or diaper.

23. A net for use as a wound contacting layer for a wound dressing formed by separation of a contoured polymer film and a carrier material which have been formed into a laminate having impressed therein a pattern of raised areas defining intersecting strands and depressed areas defining membranes between the strands, said film and carrier being adhered to each other such that upon separation the membrane areas of the contoured film adhere to the carrier material and the raised areas form the strands of the net.

# INTERNATIONAL SEARCH REPORT

International Application No **PCT/GB 90/00398**

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup> According to International Patent Classification (IPC) or to both National Classification and IPC IPC <sup>5</sup> : <b>A 61 F 13/00</b>																							
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched <sup>7</sup></div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 30%; text-align: left; border-bottom: 1px solid black;">Classification System</th> <th style="text-align: left; border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">IPC<sup>5</sup></td> <td style="padding: 5px;">A 61 F, B 29 C</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup></div>			Classification System	Classification Symbols	IPC <sup>5</sup>	A 61 F, B 29 C																	
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<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; text-align: left; border-bottom: 1px solid black;">Category <sup>9</sup></th> <th style="text-align: left; border-bottom: 1px solid black;">Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup></th> <th style="width: 20%; text-align: left; border-bottom: 1px solid black;">Relevant to Claim No. <sup>13</sup></th> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border-right: 1px solid black; padding: 5px;">EP, A, 0059049 (SMITH &amp; NEPHEW) 1 September 1982 see figures 2,3; pages 32-38</td> <td style="padding: 5px;">1,3-5,8,9, 11-22</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">--</td> <td style="padding: 5px;">2,23</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="border-right: 1px solid black; padding: 5px;">EP, A, 0010439 (GRAIN PROCESSING CO.) 30 April 1980</td> <td style="padding: 5px;">2,23</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border-right: 1px solid black; padding: 5px;">EP, A, 0050514 (SMITH AND NEPHEW) 28 April 1982 see figure 3; claim 6</td> <td style="padding: 5px;">1,3-5,8</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="border-right: 1px solid black; padding: 5px;">EP, A, 0259003 (EL PASO PRODUCTS CO.) 9 March 1988</td> <td style="padding: 5px;">1</td> </tr> <tr> <td colspan="3" style="text-align: center; padding: 5px;">-----</td> </tr> </table> <div style="font-size: small; padding: 5px;"> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p><sup>*</sup> Special categories of cited documents: <sup>14</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"G" document member of the same patent family</p> </div> </div> </div>			Category <sup>9</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>	X	EP, A, 0059049 (SMITH & NEPHEW) 1 September 1982 see figures 2,3; pages 32-38	1,3-5,8,9, 11-22	Y	--	2,23	Y	EP, A, 0010439 (GRAIN PROCESSING CO.) 30 April 1980	2,23	X	EP, A, 0050514 (SMITH AND NEPHEW) 28 April 1982 see figure 3; claim 6	1,3-5,8	A	EP, A, 0259003 (EL PASO PRODUCTS CO.) 9 March 1988	1	-----		
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<b>IV. CERTIFICATION</b> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-right: 1px solid black; padding: 5px;">           Date of the Actual Completion of the International Search  <div style="text-align: center;">19th July 1990</div> </td> <td style="width: 50%; padding: 5px;">           Date of Mailing of this International Search Report  <div style="text-align: center;">23. 08. 90</div> </td> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">           International Searching Authority  <div style="text-align: center;">EUROPEAN PATENT OFFICE</div> </td> <td style="padding: 5px;">           Signature of Authorized Officer  <div style="text-align: center;">               Natalie Weinberg           </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <div style="text-align: center;">19th July 1990</div>	Date of Mailing of this International Search Report <div style="text-align: center;">23. 08. 90</div>	International Searching Authority <div style="text-align: center;">EUROPEAN PATENT OFFICE</div>	Signature of Authorized Officer <div style="text-align: center;">               Natalie Weinberg           </div>																	
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9000398

SA 35490

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/08/90  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A- 0059049	01-09-82	AU-B- 552887	26-06-86
		AU-A- 8037582	19-08-82
		CA-A- 1174447	18-09-84
		EP-A,B 0059048	01-09-82
		GB-A,B 2093702	08-09-82
		GB-A,B 2093703	08-09-82
		JP-A- 57153644	22-09-82
		US-A- 4860737	29-08-89
		US-A- 4753231	28-06-88
EP-A- 0010439	30-04-80	US-A- 4260443	07-04-81
EP-A- 0050514	28-04-82	AT-T- E8462	15-08-84
EP-A- 0259003	09-03-88	JP-A- 63041543	22-02-88
		US-A- 4815714	28-03-89
		US-A- 4778634	18-10-88

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